

Outcome in the management of venous injury without arterial injury

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Objective We retrospectively evaluated the outcome of venous repairs in patients who underwent operation.

Method We report the management of 33 patients with venous injury without arterial injury. The mechanisms of injuries were gunshot wounds in 6 patients, stab wounds in 25, and blunt trauma in 2 patients. There were inferior caval vein injuries in 2 patients, azygos vein in 1, superior mesenteric vein in 1, external iliac vein in 4, common femoral vein in 5, superficial femoral vein in 16, and popliteal vein in 4. The management included lateral venorrhaphy in 2, venous patch angioplasty in 9, end to end anastomosis in 19, reversed saphen vein graft in 2, and ligation in 1 patient. To prevent venous thrombosis low molecular weight-dextran was used after venous repair.

Results One patient with combined thoracic and abdominal injuries died 3 days after the operation. The remaining 32 patients survived. Color duplex sonography was performed in 6 patients with abdominal venous injuries following the operation, and revealed patent veins in all cases. Postoperative venography was performed 3 months or later in 25 patients with peripheral venous injuries, 18 of whom had basically normal veins with functioning valves. In the remaining 7 patients, venography demonstrated venous thrombosis.

Conclusion We suggest that the repair of venous injuries may be the procedure of choice rather than ligation even in patients with associated visceral injuries.

Key words Venous injury, low molecular weight dextran, repair

Introduction

Controversy concerning venous reconstruction extends over the last century (1). Simple ligation should be regarded as a clinical option of choice, especially in an unstable patient with life-threatening abdominal venous injuries (2,3). Nevertheless, ligation may not be an appropriate solution in all patients (4,5). Venous injuries are usually associated with arterial injuries because of their anatomical proximity. In humans, infusion of dextran can inhibit platelet reactivity, and antithrombotic properties have been described in clinical studies (6). However the mechanism of the antithrombotic action of dextran is unknown (6). This study comprised 33 patients with venous injuries without arterial injuries. Venous repair was performed in all patients except one. The aim of this study is to discuss whether venous repair is to be preferred over ligation, and demonstrate the follow-up of such a treatment by sonography.

Material and Method

We retrospectively reviewed the records of the 33 patients operated on for injuries of venous system at the Vascular Surgery Department, SSK Antalya Hospital and Vascular Surgery Department, Yüzüncü Yıl University Hospital, Van between 1988 and 1997. All patients were male except one. The age range was 17-67 years with an average of 28 years. The mechanisms of injuries were gunshot wounds in 6, stab wounds in 25, and blunt trauma in 2 patients. There were inferior caval vein injuries in 2, azygos vein in 1, superior mesenteric vein 1, external iliac

vein in 4, common femoral vein in 5, superior femoral vein in 16, popliteal vein in 4 patients. Furthermore, 4 patients had associated abdominal injuries and 2 patients had associated thoracic injuries.

Routine laboratory examinations, ECG, and radiography were performed in all cases except 7 with unstable conditions. Ultrasonography was performed preoperatively in 7 patients with abdominal tenderness and a patient with penetrated intrathoracic gunshot wound. Venous Doppler examination was performed in 25 patients with peripheral venous injuries. The management of injured veins consisted of lateral venorrhaphy in 2 cases, venous patch angioplasty in 9, end to end anastomosis in 19, reversed saphenous vein graft in 2, and ligation in one patient.

Ultrasonography revealed intraperitoneal hemorrhage in 7 patients with abdominal tenderness, where one of them had also intrathoracic hemorrhage. One female patient with blunt trauma underwent thoracotomy initially. At thoracotomy, lung and diaphragm were found to be lacerated, and serious venous blood was coming up through the diaphragmatic tears. Lung and diaphragm were expeditiously repaired. Subsequently, the distal thoracic aorta was cross-clamped and abdomen was quickly opened. Two and a half liter of blood was evacuated from the peritoneal cavity. Abdominal exploration revealed multiple segmental injuries with infarction and laceration of the small bowel, ruptured liver, and massive venous hemorrhage from the infrarenal inferior vena cava (IVC). IVC was

reconstructed with lateral venorrhaphy and aortic cross clamp was removed. Associated injuries were repaired. Thorax and abdomen were closed. This patient died due to cerebral edema 3 days after the operation. The remaining 6 patients (5 gunshot wounds, 1 blunt trauma) underwent laparotomy. More than 2 liters of blood were evacuated from the abdominal cavity in all cases. Abdominal exploration revealed isolated external iliac vein injuries in 4 cases, superior mesenteric vein (SMV) in 1, and infrarenal inferior caval vein in 1. SMV and IVC injuries were associated with visceral injuries, both of whom were repaired with lateral venorrhaphy and end to end anastomosis respectively. There were 21 patients with femoral vein injuries and 4 with popliteal vein injuries. All peripheral venous injuries were repaired, where 2 of them required fasciotomies. In one patient with penetrated intrathoracic gunshot wound, thoracotomy was performed. At exploration, vena azygos was found to be perforated and was ligated. For the prevention of thrombosis, low molecular weight dextran, was used for 7 days after venous repair.

Results

One patient with combined thoracic and abdominal injuries died 3 days after the operation. The remaining 32 patients survived. Postoperative color Duplex sonography was performed in 6 patients with repaired abdominal venous injuries and revealed the patent repaired veins in all cases. Postoperative venography was performed after 3 months or later in 25 patients with peripheral venous injuries, 18 of whom had basically normal veins with functioning valves. In the remaining 7 patients, venography demonstrated venous thrombosis. All of these thrombotic veins were tried to recanalise by long-term anticoagulant therapy with warfarin. The managements undertaken are detailed in Table I. The mean follow-up period was 48 months, ranging from 6 months to 9 years.

Discussion

The surgeon has two goals when approaching vein injuries. The first is to insure the limb survival and the second is to restore long-term venous function (7). At least five different methods of venous repair are described including ligation, lateral suture repair, end to end anastomosis, venous patch angioplasty, and venous replacement graft. While some suggest that lateral suture repairs produce optimal patency rates, more complex repairs can produce satisfactory long-term results as well (1).

Most data in the literature support venous reconstruction and refer to a higher complication and amputation rate when venous ligation was performed (4,5). Some critics believe that all venous repairs end up in thrombosis. These condemn reconstruction, basis for this approach is, however, predominantly anecdotal (1). Regardless of long-term results, venous patency during the initial 2 weeks following the injury perhaps improves patency rates in a new arterial anastomosis before development of collateral venous canals (1). Moore et al advocate that venous patency for 2 weeks after reconstruction virtually assures long-term patency (8,9). Injuries to the major veins in the lower extremity should be repaired rather than ligated whenever feasible (10). Our data suggest that venous repairs may provide substantial benefit.

The only disadvantage of venous repair is the time required for the repair, and possibly the only indications for venous ligation are complex lacerations or associated injuries that require priority (7). Ligation is usually well tolerated in young, previously healthy individuals (11). The choice of the venous replacement graft is most controversial. Experimental and clinical evidence shows superiority of autogenous versus other types of grafts, particularly in the lower extremity (12). We also used saphenous vein graft in 2 patients.

Abdominal venous injuries constitute one of the most lethal forms of trauma, with mortality in some series exceeding 30% (13,14). This is due to both the

Table I. Distribution of the patients according to method of repair

Injured vein	Ligation	Lateral venorrhaphy	Venous angioplasty	End to end anastomosis	Saphenous graft	Total
Azygos vein	1					1
VCI		2				2
SMV				1		1
Ext. iliac vein			3	1		4
Com. femoral vein			2	3		5
Sup. femoral vein			2	14		16
Popliteal vein			2		2	4
Total	1	2	9	19	2	33

VCI: vena cava inferior, SMV: superior mesenteric vein.

frequent associations of other major injuries and the degree of rapid bleeding associated with venous lacerations. In such individuals, laparotomy usually causes a further deterioration unless the aorta is almost immediately cross clamped. Although abdominal aortic occlusion can be accomplished in experienced hands, a prelaparotomy thoracotomy has usually given better results, if the injuries involved upper abdominal structures (15). However, the role of a prelaparotomy thoracotomy for abdominal injuries with severe persisting shock in spite of aggressive resuscitation is still debated (2). Although, patients with abdominal venous injuries have a high mortality rate regardless of how they are managed, a thoracotomy can be of value. In the patients with thoracic injury requiring thoracotomy, perhaps distal thoracic aortic cross-clamping may be performed in patients with life-threatening upper abdominal venous injuries, as was done in one of our patients.

Although repair of iliac veins is recommended whenever possible, these vessels should just be ligated if the injury is extensive, if the patient unstable, or if there are other multiple severe injuries (11). Aitken et al reported that ligation of the external iliac vein or superficial femoral vein was associated with abnormal function tests and edema (7). We preferred venous reconstruction rather than ligation in 4 patients with iliac vein injuries. Postoperative recovery was uneventful in all cases without limb edema.

The specific management of the SMV injury has been and still is a topic of controversy (16). Venous repair of the SMV has been advocated only in cases where a simple, easily repaired laceration in patients without concomitant life-threatening injuries occurred (17,18). Contrarily, Flis advocate that even with associated and severe multiple injuries, reconstruction of the SMV should be performed in any case where ligation would present a real threat to the small bowel viability and patient's life (16). In our patient with combined SMV and visceral injuries, SMV was reconstructed to avoid probable life-threatening complications.

Combined arterial and venous injuries are more serious than venous injuries alone (14,19,20). The normal revascularization edema that follows limb ischemia is aggravated when the vein is ligated. It has been suggested that if thrombosis occurs in the vein after a repair, there is little evidence for the increased risk of a subsequent pulmonary embolus is (7). While thrombosed veins frequently recanalize, the process destroys functioning valves. This produces venous hypertension and resultant chronic stasis problems (1). In our patients, venous thrombosis developed in 7 patients, while there were no cases with any suspicion of pulmonary embolus.

Whether therapeutic anticoagulation enhances anatomic or symptomatic results of vein repair beyond reducing the occurrence of deep venous thrombosis is unclear (21). The importance of other perioperative techniques such as postoperative limb elevation, arteriovenous fistulae, stockings, and long-term anticoagulation with warfarin remains unproved but they are all theoretically attractive (22). Experimentally, low molecular weight dextran has been shown to be superior to heparin (23). Since contraindications to systemic anticoagulation are often present in trauma victims, it is encouraging that success is possible without heparin.

The risk of deep venous thrombosis is substantial for immobilized patients, and the risk may increase after major lower extremity trauma (24). Venous injury adds endothelial damage as a risk factor. It seems unlikely that venorrhaphy more often than ligation predisposes to deep venous thrombosis or pulmonary embolus. To prevent venous thrombosis, we have routinely used low molecular weight dextran without the use of heparin as artificial plasma substitute. In our patients, venous thrombosis developed only in 7 patients (22%). These thrombosed veins were recanalized after warfarin treatment. One patient who not survived, required transfusion of more than 10 units. There is an increased mortality rate in patients requiring transfusion of more than 10 units blood (15).

In conclusion, we suggest that: 1. the repair of venous injuries may be a procedure of choice rather than ligation even in patients with associated visceral injuries; 2. thromboprophylaxis should be done with low molecular weight dextran as plasma substitute without the use of heparin in patients with venous injuries.

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